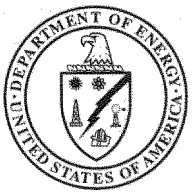
DOE/ID-11118
Revision 0
Project No. 23507
December 2003



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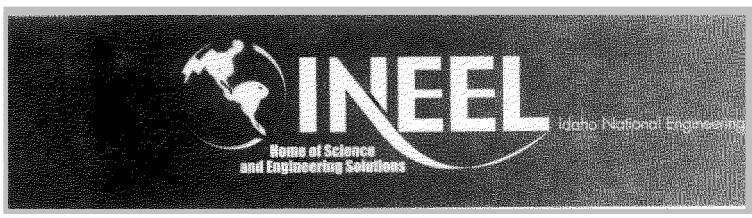
Idaho Operations Office

Annual INTEC Groundwater Monitoring Report for Group 5–Snake River Plain Aquifer (2003)



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Prepared for the
U.S. Department of Energy
DOE/NE Idaho Operations Office

ABSTRACT

This report describes the monitoring activities conducted, and presents the results of groundwater sampling and water-level measurements from October 2002 to September 2003. Groundwater samples were collected from 20 wells at the Idaho Nuclear Technology and Engineering Center (INTEC) and the Central Facilities Area (CFA) and analyzed for iodine-129, strontium-90, tritium, gross alpha, gross beta, technetium-99, uranium isotopes, plutonium isotopes, neptunium-237, americium-241, gamma spectrometry, and mercury. Samples from 17 wells were collected in April and May 2003. Additional deep packer sampling was conducted in July and August, 2003, at three wells.

Strontium-90, technetium-99, and gross alpha were detected above their respective maximum contaminant levels. Strontium-90 was above its maximum Contaminant level of 8 pCi/L in several wells near INTEC but was below its maximum contaminant level in the downgradient wells at the CFA landfills. Technetium-99 was detected above its maximum contaminant level of 900 pCi/L in one well within INTEC but was below the maximum contaminant levels at all other locations. Gross beta results generally mirrored the results for strontium-90 and technetium-99. Gross alpha was above its maximum contaminant level in one well and at the maximum contaminant level in another well within INTEC but was below maximum contaminant levels downgradient of INTEC.

Among the plutonium isotopes, only plutonium-2391240 was detected, and the concentration was near the detection limit at one location. Neptunium-237 was not detected. Uranium-233/234 and uranium-238 isotopes were similar to background concentrations. Uranium-235/236 was detected in 11 samples, but all the detected concentrations were similar and near the minimum detectable activity. The gamma spectrometry results detected cesium-137 in three samples at low concentrations. The plutonium, uranium, and cesium-137 detections were below maximum contaminant levels.

Water-level measurements were taken from wells in INTEC, CFA, and the area south of CFA to evaluate groundwater flow directions. Water-level measurements indicated groundwater flow to the south-southwest from INTEC.

CONTENTS

ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Central Facilities Area
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
FFA/CO	Federal Facility Agreement and Consent Order
ICPP	Idaho Chemical Processing Plant
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LTMP	Long-Term Monitoring Plan
MCL	maximum contaminant level
MDA	minimum detectable activity
MSIP	Monitoring System and Installation Plan
ou	operable unit
PBF	Power Burst Facility
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SRPA	Snake River Plain Aquifer
STF	Security Training Facility
USGS	United States Geological Survey
WAG	waste area group

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1. INTRODUCTION

The purpose of this document is to report the groundwater sampling results and water-level measurements conducted to support the Waste Area Group (WAG) 3, Operable Unit (OU) 3-13, Group 5, Snake River Plain Aquifer (SRPA) monitoring at the Idaho Nuclear Technology and Engineering Center (INTEC). The OU 3-13 Record of Decision (ROD) calls for Group 5 to monitor contaminant migration in the SRPA associated with the INTEC facility ([DOE-ID] 1999). The Long-Term Monitoring Plan (LTMP) (DOE-ID 2003a) specified the wells to be sampled and the parameters for analysis based on the data requirements identified in the ROD (DOE-ID 1999). The data quality objectives for the groundwater sampling are described in the Monitoring System and Installation Plan (MSIP) (DOE-ID 2003b) and LTMP (DOE-ID 2003a).

1.1 Regulatory Background

The Idaho National Engineering and Environmental Laboratory (INEEL) is divided into 10 WAGs to manage environmental operations mandated under the *Federal Facility Agreement and Consent Order* (FFA/CO) (DOE-ID 1991). INTEC, formerly the Idaho Chemical Processing Plant (ICPP), is designated as WAG 3. Operable Unit 3-13 encompasses the entire INTEC facility.

In October 1999, the ROD was issued for OU 3-13, which includes the INTEC perched and groundwater systems (DOE-ID 1999). The remedial actions chosen in the ROD are in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (42 USC §9601a) as amended by the Superfund Amendments and Reauthorization Act of 1986 (42 USC 9601b). In addition, remedies comply with the National Oil and Hazardous Substances Pollution Contingency Plan (55 FR 8665) and are intended to satisfy the requirements of the FFA/CO.

Under the FFA/CO, the U.S. Environmental Protection Agency (EPA), the Idaho Department of Environmental Quality, and the U.S. Department of Energy (DOE) are directing cleanup activities to reduce risks to human health and the environment at INTEC to acceptable levels.

1.2 Site Background

The INEEL is a government-owned facility managed by the DOE. The eastern boundary of the INEEL is located 52 km (32 mi) west of Idaho Falls, Idaho. The INEEL Site occupies approximately 2,305 km^2 (890 mi^2) of the northwestern portion of the Eastern Snake River Plain in southeast Idaho. The INTEC facility covers an area approximately 0.39 km^2 (0.15 mi^2) and is located approximately 72.5 km (45 mi) from Idaho Falls, in the south-central area of the INEEL as shown in Figure A-1, Appendix A.

INTEC has been in operation since 1952. Its original mission was to reprocess uranium from defense-related projects and to research and store spent nuclear fuel. The DOE phased out the reprocessing operations in 1992 and redirected the plant's mission to (1) receipt and temporary storage of spent nuclear fuel and other radioactive wastes for future disposition, (2) management of current and past wastes, and (3) performance of remedial actions.

The liquid waste generated from the past reprocessing activities is stored in an underground tank farm. Numerous CERCLA sites are located in the area of the tank farm and adjacent to the process equipment waste evaporator. Contaminants found in the soils of the tank farm are the result of accidental releases and leaks from process piping, valve boxes, and sumps and from cross-contamination from operations and maintenance excavations. No evidence has been found to indicate that the waste tanks themselves have leaked. The contaminated soils at the tank farm comprise about 95% of the known contaminant inventory at INTEC. The comprehensive remedial investigation/feasibility studies for OU 3-13 (DOE-ID 1997a, 1997b, 1998) contain a complete discussion of the nature and extent of contamination.

1.3 Environmental Setting

The environmental setting is summarized here, and a complete description is given in DOE-ID (1997a, 1997b, 1998). The SRPA underlies INTEC and the Eastern Snake River Plain and has been designated by the EPA as a sole source aquifer for the region. The aquifer lies at a depth of about 137 m (450 ft) beneath the INEEL Site. Groundwater in the SRPA generally occurs under unconfined conditions but locally may be quasi-artesian or artesian (Nace et al. 1959). Regional groundwater flow is southwest at an average estimated velocity of 1.5 m/day (5 ft/day). The average groundwater flow velocity at INTEC is estimated at 3 m/day (10 ft/day) due to local hydraulic conditions. Hydraulic characteristics of the aquifer differ considerably from place to place depending on the saturated thickness and the characteristics of the basalts and sedimentary interbeds.

Recharge to the aquifer is primarily by valley underflow from the mountains to the north and northeast of the plain and from infiltration of irrigation water. A small amount of recharge occurs directly from precipitation. Recharge to the aquifer within INEEL boundaries is primarily by underflow from the northeastern part of the plain and the Big Lost River (Bennett 1990). Significant amounts of recharge from the Big Lost River have caused water levels in some wells at the INEEL to rise as much as 1.8 m (6 ft) within a few months after high flows in the river (Barraclough, Lewis, and Jensen 1982). Locally, the direction of groundwater flow is temporarily changed by recharge from the Big Lost River (Bennett 1990).

The source of contamination in the SRPA originates primarily from the former INTEC injection well (CPP-23). However, contaminated soils and perched water are predicted to contribute to future SRPA contamination. The iodine-129 (I-129), strontium-90 (Sr-90), and plutonium isotopes were found to be the only contaminants that potentially pose an unacceptable risk to a hypothetical future resident beyond the year 2095 (DOE-ID 1999). The primary I-129 source was the former injection well. The primary Sr-90 sources were the former injection well and the tank farm soils. The primary source of plutonium isotopes is the tank farm. The major human health threat posed by contaminated SRPA groundwater is exposure to radionuclides via ingestion by future groundwater users.

2. MONITORING PROGRAM AND RESULTS

The WAG 3, Group 5 monitoring activities consisted of groundwater sampling and water-level measurements. Water-level measurements were taken in May 2003. Groundwater was sampled from 16 wells in April and May 2003. In late July 2003, three deep packer samples were collected below the HI interbed at United States Geological Survey (USGS) wells USGS-41, USGS-48, and USGS-59 in accordance with the LTMP (DOE-ID 2003a).

2.1 Groundwater Sampling Results

The LTMP called for sampling 18 wells near and to the south of INTEC and collecting three deep packer samples. Samples were collected from 16 of the 18 wells from April 13 to May 31, 2003. Wells USGS-122 and USGS-49 were not sampled. USGS-122 has a problem with its sampling pump and USGS-49 has an obstruction or has collapsed.

Groundwater samples were analyzed for tritium, Sr-90, I-129, uranium isotopes, plutonium isotopes, americium-241 (Am-241), mercury, gamma spectrometry, neptunium-237 (Np-237), technetium-99 (Tc-99), and gross alpha/beta activities in accordance with the LTMP. The data analysis will focus on tritium, I-129, Tc-99, Sr-90, and gross beta, because these parameters are elevated in groundwater downgradient of INTEC. The results for these five parameters are summarized in Table A-1, Appendix A. The results for uranium isotopes, cesium-137 (Cs-137), Am-241, Np-237, and plutonium isotopes are summarized in Table A-2, Appendix A.

A complete listing of the analytical results is given in Appendix B. Throughout the text of this report, only the concentrations for radiological analytes are provided. The uncertainties associated with the reported radiological results are provided in Tables A-1 and A-2 (Appendix A) and in Appendix B.

In the following subsections, monitoring well results are compared to maximum containment levels (MCLs) for drinking water. The monitoring wells are not used as a source of drinking water. The use of MCLs is for comparison purposes only.

2.1.1 Iodine-129

The groundwater sampling results indicate that an I-129 plume extends from INTEC into the Central Facilities Area (CFA) area. The highest I-129 concentration was detected in LF3-08 (0.77 pCi/L) at the CFA landfills, but all I-129 concentrations are below the MCL of 1 pCi/L (Figure A-2, Appendix A). In contrast, I-129 was over 1 pCi/L in 12 wells in the 1991 groundwater sampling event, and the two CFA landfill wells were slightly above the MCL in 2001. Groundwater sampling below the HI interbed at wells USGS-41, -48, and -59 indicated that I-129 was at low concentrations (equal to or less than 0.25 pCi/L) below the HI interbed.

Trend analysis of the I-129 data indicates that I-129 is decreasing at most locations except at CFA-1, which does not show a distinct trend (Figure A-3, Appendix A). Additional data from the sitewide drinking water program were used for CFA-1 trend plot. Trend analysis for I-129 is hindered by the lack of data from 1990 to 2001. Iodine-129 data were collected in 1995, but these data had a much higher minimum detectable activity (MDA) of approximately 0.5 to 1 pCi/L. For the 2003 samples, the MDA for I-129 was approximately 0.1 pCi/L and is given in Appendix B for each sample.

2.1.2 Tritium

The tritium results indicate a plume extending from INTEC into CFA and beyond, but all wells were below the MCL of 20,000 pCi/L (Figure A-4, Appendix A). The highest tritium Concentration was 13,700 pCi/L at MW-18. The MDA for tritium was 300 to 400 pCi/L. Overall, the tritium results from the 2003 sampling event were generally lower than the results from the 2001 sampling event (DOE-ID 2002). Tritium concentrations were low (992 to 2080 pCi/L) in the three wells that were packer-sampled below the HI interbed.

Trend analysis of data from select wells within the tritium plume since 1985 indicates that tritium is decreasing at most locations (Figure A-5, Appendix A). Most of the data shown for select wells within the tritium plume on Figure A-5 are from USGS sampling. Except for USGS-47, a consistent downward trend in tritium concentrations is observed.

2.1.3 Strontium-90

Sr-90 was detected at 13 of 16 well locations sampled, with the highest Sr-90 concentration, 33.9 pCi/L, occurring in the duplicate sample for USGS-47. The minimum detectable activity for Sr-90 for each sample is listed in Appendix **B** and was typically less than 1 pCi/L for the samples collected in April and May of 2003. Eight wells were above the MCL, **8** pCi/L, for Sr-90. The distribution of Sr-90 in the SRPA indicated a plume extending south of INTEC to the CFA landfills (Figure A-6, Appendix A). ***An*** increasing trend in Sr-90 activity is occurring at LF3-08 located at CFA Landfill III (Figure A-7, Appendix A). The increase in Sr-90 at LF3-08 suggests that the Sr-90 plume axis is to the west of the CFA production wells. Sr-90 concentrations ranged from 8.53 to 9.91 pCi/L in the three samples collected below the HI interbed and were just above the MCL **of 8** pCi/L.

Trend analysis of six wells within the Sr-90 plume indicates that Sr-90 is steadily decreasing at most locations, except USGS-47, which does not show **a** distinct trend, and LF3-08, which shows an increasing trend (Figure A-7, Appendix A). Most of the data shown on Figure A-7 (Appendix **A)** are from USGS sampling.

2.1.4 Technetium-99

Tc-99 was detected at 12 locations, with the highest level, 2,840 pCi/L, occurring at ICPP-MON-A-230 near the INTEC tank farm in the August 2003 sampling event. This well was the only location that exceeded the Tc-99 MCL of 900 pCi/L. The highest Tc-99 concentration occurred at the same location as the highest gross beta concentration and the highest gross alpha. The minimum detectable activity for Tc-99 was typically 5 to 9 pCi/L. Tc-99 concentrations downgradient of INTEC in the CFA landfill wells ranged from below detection limits to 70.4 pCi/L. Tc-99 was detected at two of the three locations sampled below the HI interbed with the highest concentration, 36.9 pCi/L, occurring at USGS-59. The distribution of Tc-99 in the SRPA is shown on Figure A-8, Appendix **A.**

Wells LF3-08 and ICPP-MON-A-230 were resampled for Tc-99 on August 11, 2003, to verify the high concentrations, and the original samples were reanalyzed (Table A-3, Appendix A). The high Tc-99 concentration for LF3-08 in the May sampling of LF3-08 was suspicious, because the gross beta was low, a rinsate sample was also high in Tc-99 (533 pCi/L), and the concentration was several orders of magnitude higher than previous historical data. The cause of the high Tc-99 concentration in the rinsate is unknown since the sample labeling and handling procedures specific to the Field Sampling Plan (DOE-ID 2003c) were followed. The reanalysis of the original May samples from LF3-08 and ICPP-MON-A-230 agreed statistically with the original results. The reanalysis results show that aliquots

taken from the sample bottles are reproducible but do not eliminate the possibility that a laboratory labeling error was made.

Samples taken on August 11,2003, were taken in duplicate and sent to two separate laboratories (Table A-3, Appendix A). The resampling results for ICPP-MON-A-230 were consistent with the May results. The results for LF3-08 were inconsistent with the previously reported result for the May sampling. As a result of the resampling, the Tc-99 value for LF3-08 May 2003 sample was qualified "R' (rejected), because the value is inconsistent with the resampling results and with historical results.

Tc-99 concentration trends are plotted for four wells near INTEC using available data (Figure A-9, Appendix A). The lack of Tc-99 data makes determination of trends uncertain at best. Additional data from the State oversight program were used in the Tc-99 plot for USGS-I 12. Plots for several wells downgradient of INTEC, such as USGS-112, USGS-57, and USGS-67, show trends of gradually increasing concentrations, but Tc-99 concentrations in these wells are well below the MCL of 900 pCi/L. Well USGS-52 located within INTEC—southeast of the tank farm—also shows increasing concentrations. A trend plot was not done for the well with the highest Tc-99 concentration, ICPP-MON-A-230, because 2003 was the first time that the well was sampled. The source of the high Tc-99 concentration in ICPP-MON-A-230 is currently being investigated (ICP/EXT 2003). The results of the Tc-99 investigation will be reported in a WAG 3, Group 4 report.

2.1.5 Gross Alpha/Gross Beta

Gross alpha was above its MDA (approximately 1.8 to 3 pCi/L) at 11 locations with detections ranging from 2.23 to 32.7 pCi/L. Gross alpha was also detected in two of three samples collected below the HI interbed at concentrations of 2.06 and 3.06 pCi/L. The highest gross alpha level, 32.7 pCi/L, occurred in ICPP-MON-A-230 and was above the MCL of 15 pCi/L. The other wells with high gross alpha, MW-18 (15 pCi/L) and USGS-52 (13.2 pCi/L), also had elevated Tc-99 concentrations and were near the tank farm. The cause of the high gross alpha readings is unknown, since plutonium isotopes, neptunium-237, and americium-241 were below detection limits and uranium isotopes were at background concentrations at these locations.

Gross beta was above its MDA (typically 3 to 4 pCi/L) at 16 of 17 well locations, and results varied from 4.25 to 931 pCi/L. Gross beta was also detected in all three samples from below the HI interbed and ranged from 18.6 to 33.2 pCi/L. The highest gross beta level occurred at ICPP-MON-A-230. The MCL for gross beta is 4 mrem/yr. The distribution of gross beta in the SRPA shows an area above 50 pCi/L extending from INTEC south to beyond USGS-112 (Figure A-10, Appendix A). The gross beta results generally correlate with the Sr-90 and Tc-99 results (see Table A-I, Appendix A).

2.1.6 Uranium Isotopes

U-233/234 (U-233/234) was above the minimum detectable activity (average 0.08 pCi/L) in all samples. The range of U-233/234 detected was from 0.744 to 1.93 pCi/L and includes the samples collected below the HI interbed. The narrow range of concentrations and the occurrence of 1.54 pCi/L in the upgradient well, USGS-121, suggest that the occurrence of U-233/234 is natural. Similarly, U-238 was above the MDA (average 0.06 pCi/L) at all locations including the three samples from below the HI interbed, with a range from 0.489 to 1.0 pCi/L, and the upgradient well, USGS-121, contained 0.788 pCi/L. The narrow range of detections and a background concentration similar to that detected at and downgradient of INTEC suggest that the U-238 occurrences are natural. In addition, the concentrations of U-233/234 and U-238 are consistent with background concentrations for total uranium in groundwater in Idaho of 0 to 9 pCi/L (Orr, Cecil, and Knobel 1991).

Uranium-235/236 was above the MDA at 10 locations and one packer sample from below the HI interbed, including the background location, and ranged in concentration from 0.042 pCi/L to 0.22 pCi/L. The highest concentration of U-235/236 occurred in the packer sample from USGS-48. All the detections of U-235/236 were close to the average MDA (0.05 pCi/L).

2.1.7 Plutonium Isotopes, Neptunium-237, and Americium-241

Pu-239/240 was detected at one location, LF2-08, at a concentration of 0.0373 pCi/L near the detection limit of 0.0317 pCi/L. Plutonium-241 was reported in the packer groundwater sample from monitor well USGS-48 at an activity of 8.99 ± 2.54 pCi/L. No data qualifiers were assigned to the reported value, and this activity is slightly above the minimum detectable activity (MDA) of 7.29 pCi/L. The result is questionable since the other isotopes of plutonium (Pu-238, Pu-239/240) were not detected in the sample. Because plutonium isotopes typically occur together, the reported detection of Pu-241 in the absence of the other isotopes calls the result for USGS-48 into question. Neptunium-237 was not detected at any of the sampling locations. The MDAs for neptunium-237 and plutonium isotopes are listed in Appendix B.

Am-241 was detected at USGS-123 at 0.0136 pCi/L, but that concentration is less than the concentration of Am-241 in a rinsate sample at 0.0263 pCi/L. Both of the Am-241 detections were close to the MDA (Appendix B). Am-241 was not detected in the three packer samples collected below the HI interbed.

2.1.8 Gamma Spectrometry

The gamma spectrometry analysis for the 16 wells sampled in April and May 2001 detected Cs-137 and manganese-54. No analytes were detected in the gamma spectrometry analysis of the three packer samples collected below the HI interbed. The list of analytes included in the gamma spectrometry analysis includes antimony-125; cerium-144; Cs-134 and -137; cobalt-60; europium-152, -154, and -155; manganese-54; ruthenium-106; silver-108 and -110; zinc-65; and zirconium-95. The minimum detectable activities for the above radionuclides are listed in Appendix B.

Cs-137 was detected at USGS-40, USGS-42, and USGS-47 at levels of 9.73, 18.4, and 5.15 pCi/L, respectively (6.97 pCi/L for the USGS-47 duplicate) (Table A-2, Appendix **A).** Manganese-54 was detected at a concentration of 3.52 pCi/L, or just above the detection limit, in USGS-052.

2.1.9 Mercury

Mercury was detected at four wells, with the highest concentration of 0.185 µg/L in the duplicate sample from USGS-47. The detection limit for mercury was 0.1 µg/L. The MCL for mercury is 2 µg/L. Mercury was not detected in the three packer samples collected below the HI interbed.

2.2 Water-Level Measurements

Water-level measurements were taken in May 2003 for select wells in the INTEC, CFA, Power Burst Facility (PBF), and Radioactive Waste Management Complex (RWMC) areas to determine the direction of groundwater movement. The area encompassed by water-level measurements was expanded from the area covered in the LTMP because of the flat gradient in the vicinity of INTEC and the need to include the area of the INTEC groundwater plumes. Several wells in the vicinity of INTEC that were proposed for water-level measurement in the LTMP, including USGS-43, ICPP-MON-A-021, and ICPP-MON-A-022, were not used for water-level measurements because of access problems or malfunctioning water-level indicators. In addition, water-level measurements were taken at wells LF2-11,

MW-18, TRA-08, and USGS-121, but these wells were not used to construct the contour map because of anomalous readings. In addition, the highly deviated well USGS-111 was not used, because it is located near other wells that are not highly deviated.

The depth to groundwater was determined using surveyed measuring-point elevations and well-deviation correction factors. Water-level measurements were adjusted for borehole deviation using correction factors that are based on gyroscopic and/or magnetic deviation surveys. Borehole deviation data, either photogyroscopic, magnetic, or digital gyroscopic, are available for all wells used to construct the water-level maps, except for USGS-107. Water-level measurements taken at wells with less than 0.1 ft of vertical deviation from the true depth were not adjusted for deviation, because deviation measurements have an uncertainty associated with them. The water-level measurement data and borehole deviation correction values are presented in Table A-4, Appendix A.

A groundwater-level contour map for May 2003 shows that the general direction of groundwater flow from INTEC is south to southwest (Figure A-11, Appendix A). At CFA, the flow ranges from southeast to southwest.

The groundwater hydraulic gradient in the area covered by the water-level measurements varies considerably (Figure A-11, Appendix A). The gradient is relatively flat over the area between INTEC and the CFA landfills (more than 1 mi) with less than 2 ft of head difference. Steeper gradients are present south of CFA, near the RWMC, and in the vicinity of the PBF. There is nearly a 13 ft difference in groundwater elevation from M12S to M13S (~1 mi) near the RWMC and approximately 24 ft from PBF-MON-A-001 to Security Training Facility (STF)-MON-A-003, over a distance of approximately 2-1/4 mi.

3. CONCLUSIONS AND RECOMMENDATIONS

Sampling and analysis results for 2003 confirm that concentrations of tritium, I-129, and Sr-90 continue to decline in the SRPA at and downgradient of INTEC. Tritium and 1-129 concentrations were below MCLs in all wells sampled during 2003. Sr-90 concentrations remained above the MCL (8 pCi/L) at eight of the 16 monitoring wells sampled in 2003, but Sr-90 levels had declined at most locations from concentrations observed in 2001.

In contrast, Tc-99 concentrations in the SRPA appear to have increased slightly at several locations, though lack of historical Tc-99 data make this conclusion tenuous. The MCL for Tc-99 (900 pCi/L) was exceeded at one location, new aquifer monitoring well ICPP-MON-A-230 located north of the INTEC tank farm. The occurrence of elevated Tc-99 in groundwater at this location demonstrates the need for additional investigations to identify the source or sources of Tc-99 to the SRPA.

The constituent(s) causing the high gross alpha results at ICPP-MON-A-230 and MW-18 should be evaluated by performing an alpha speciation analysis to determine what might be causing the elevated gross alpha concentrations in these wells.

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Appendix A

Figures and Tables

FIGURES

TABLES

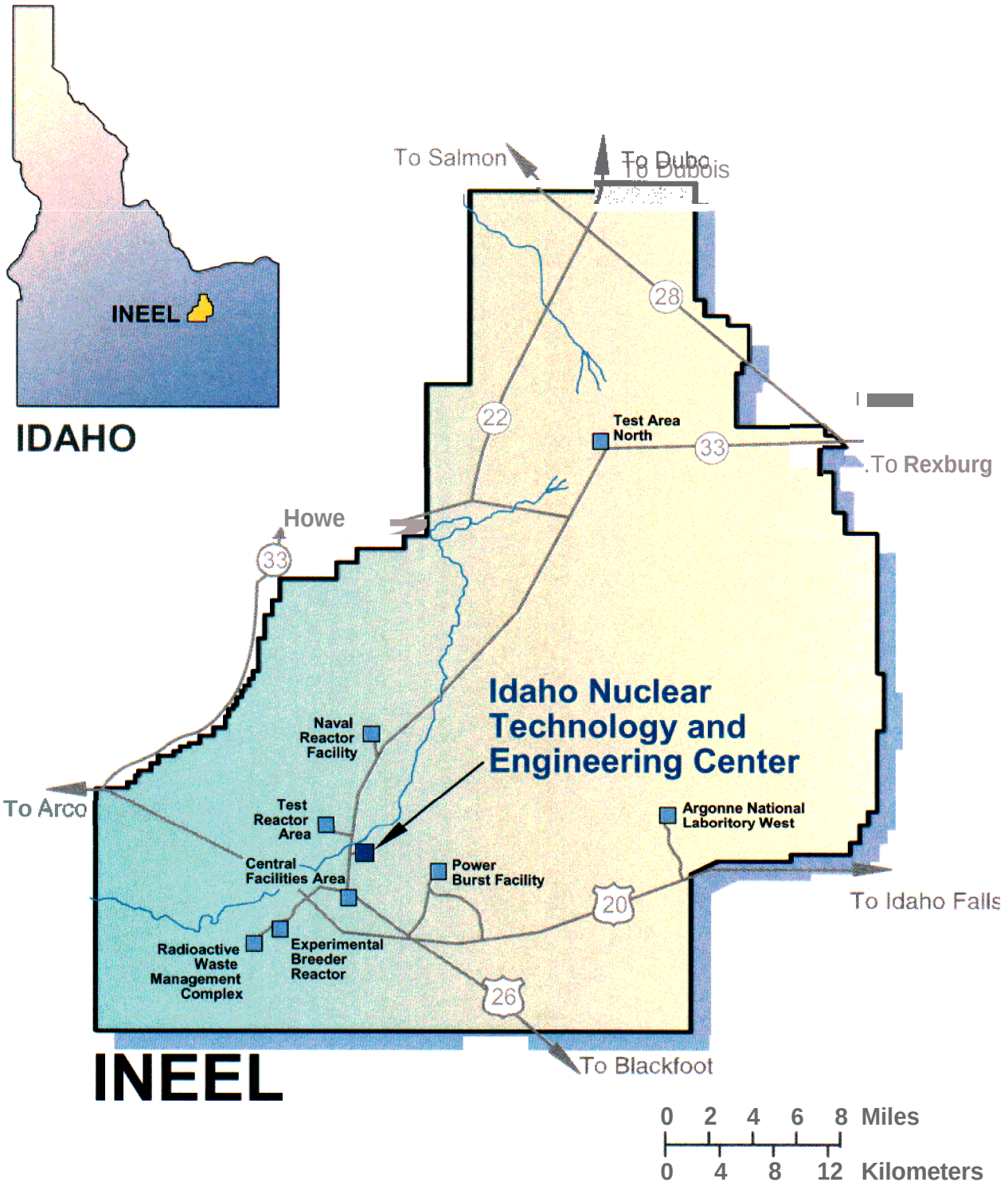

Figure **A-1. Map** showing location of **INTEC at the** INEEL.

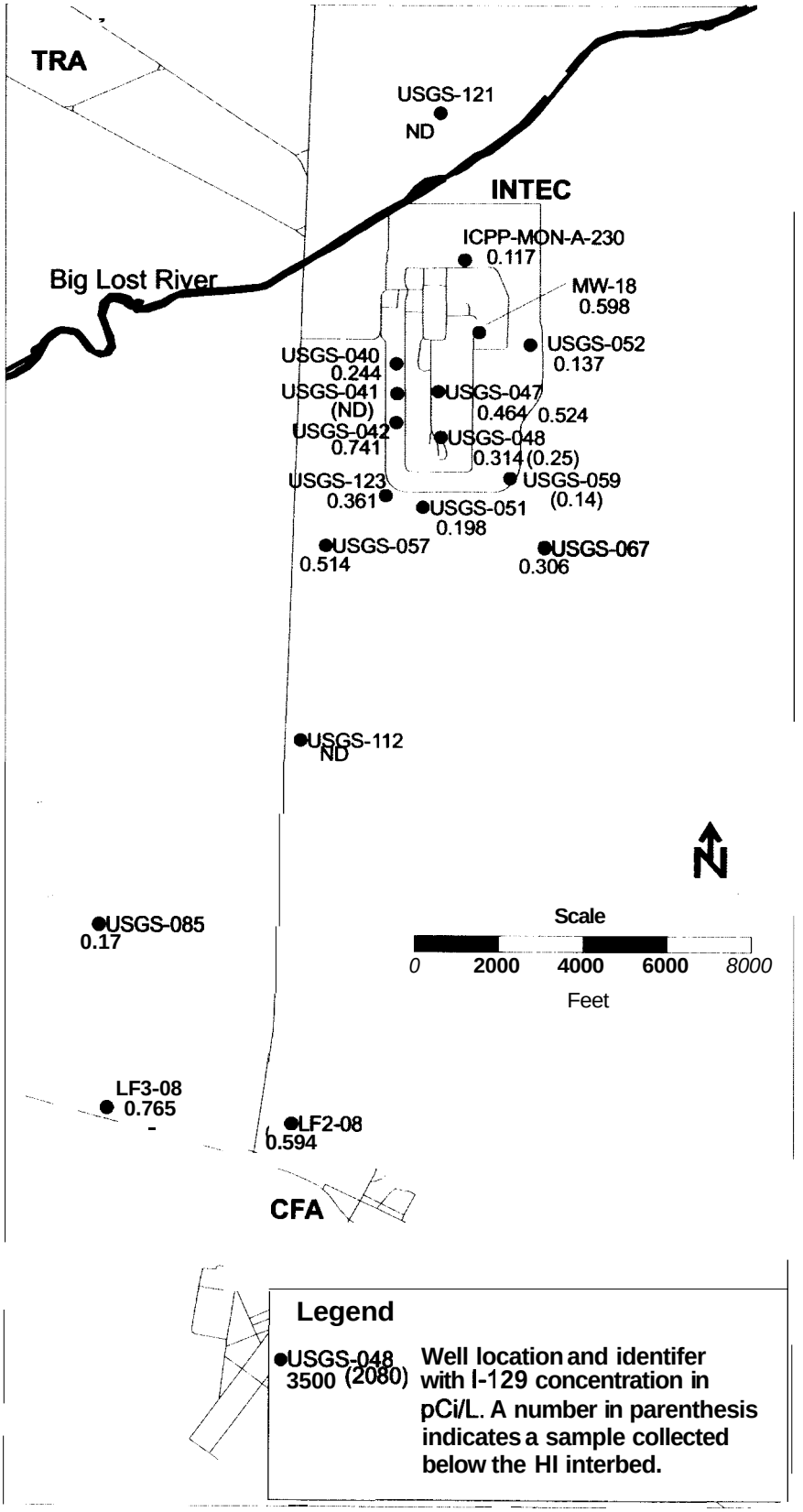

Figure A-2. Distribution of 1-129(pCi/L) in the **Snake** River Plain Aquifer in 2003.

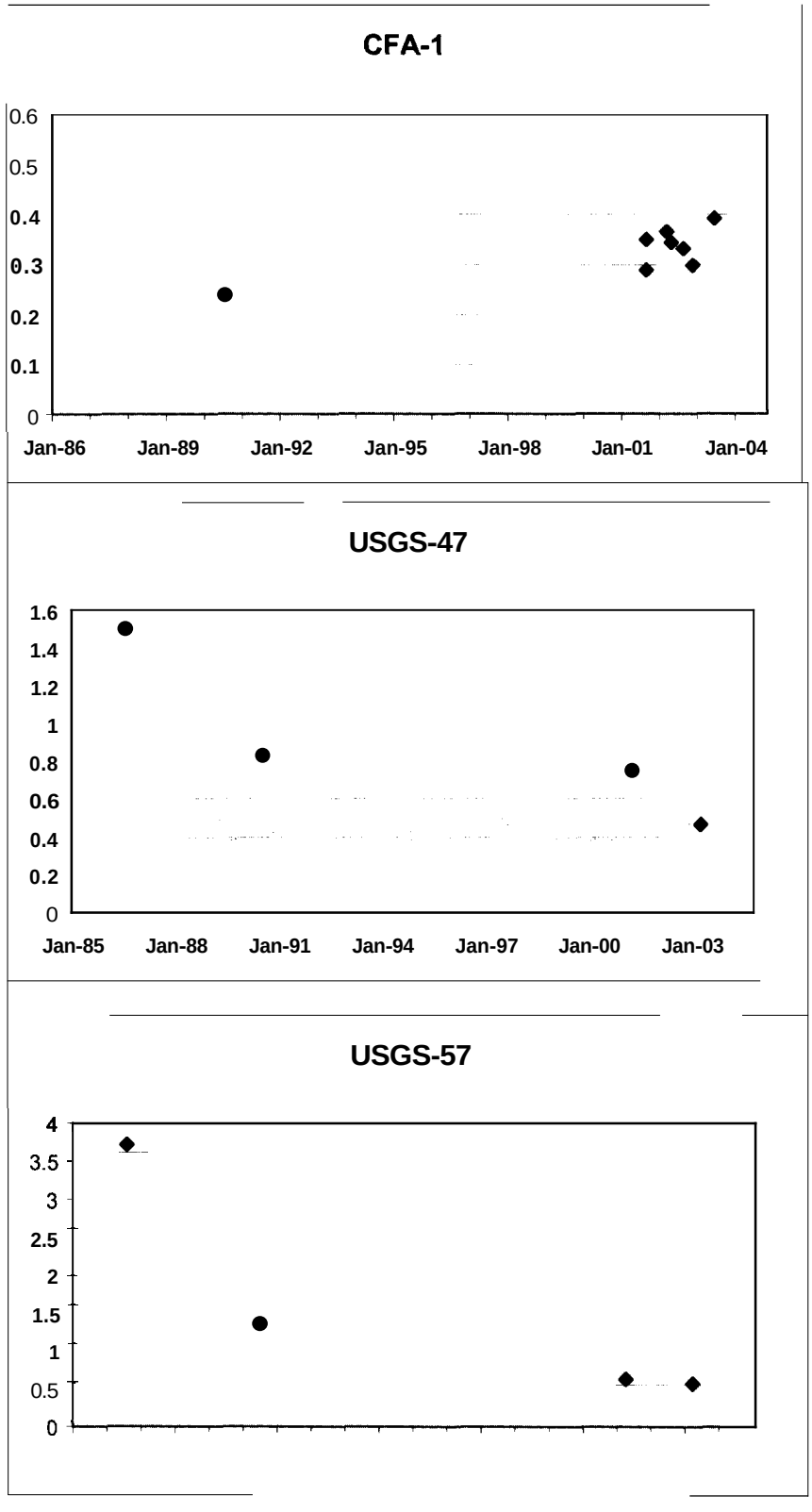

Figure **A-3.** Iodine-129 concentration (pCi/L) trends for select wells near INTEC.

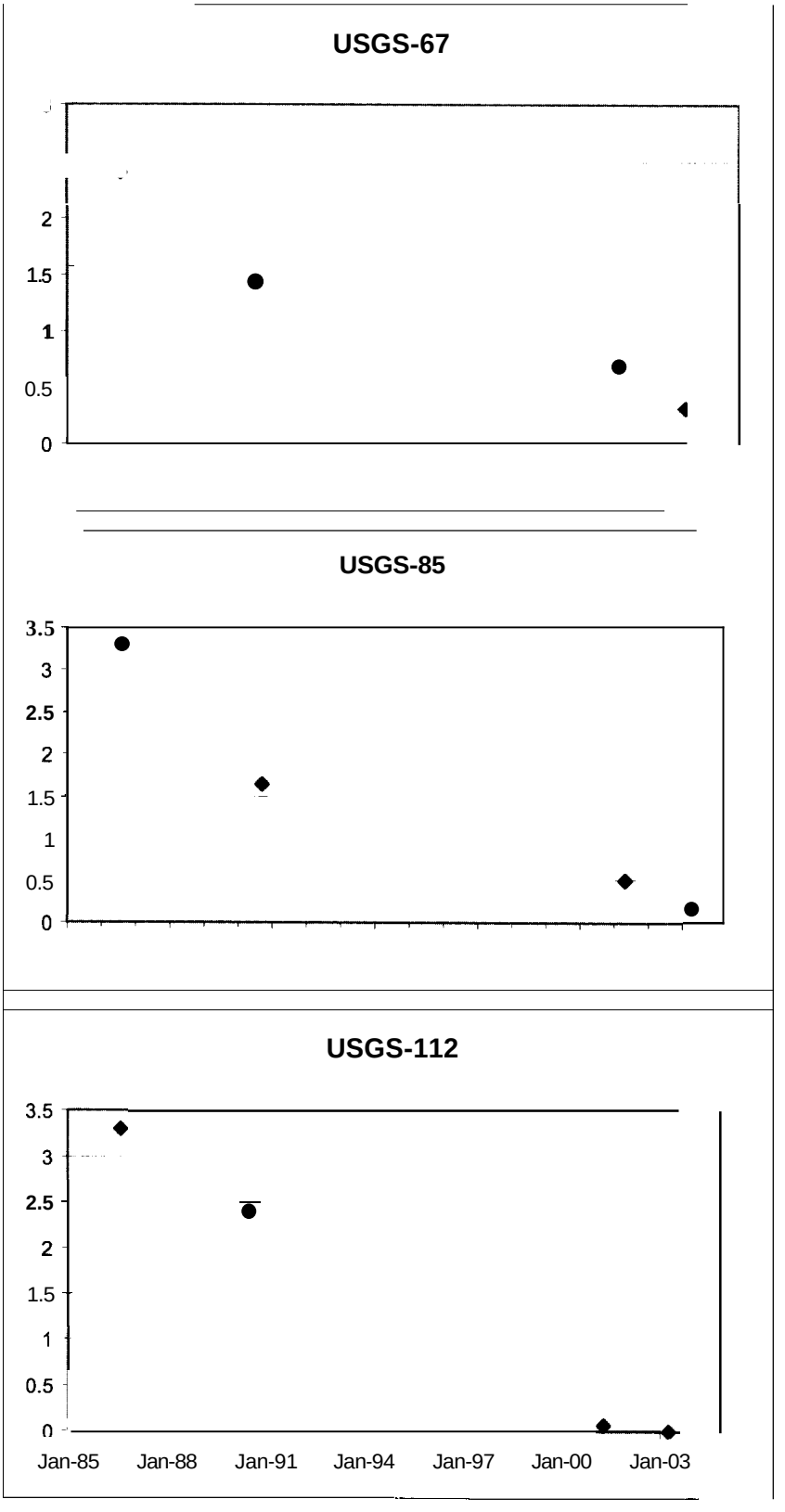

Figure **A-3.** (continued).

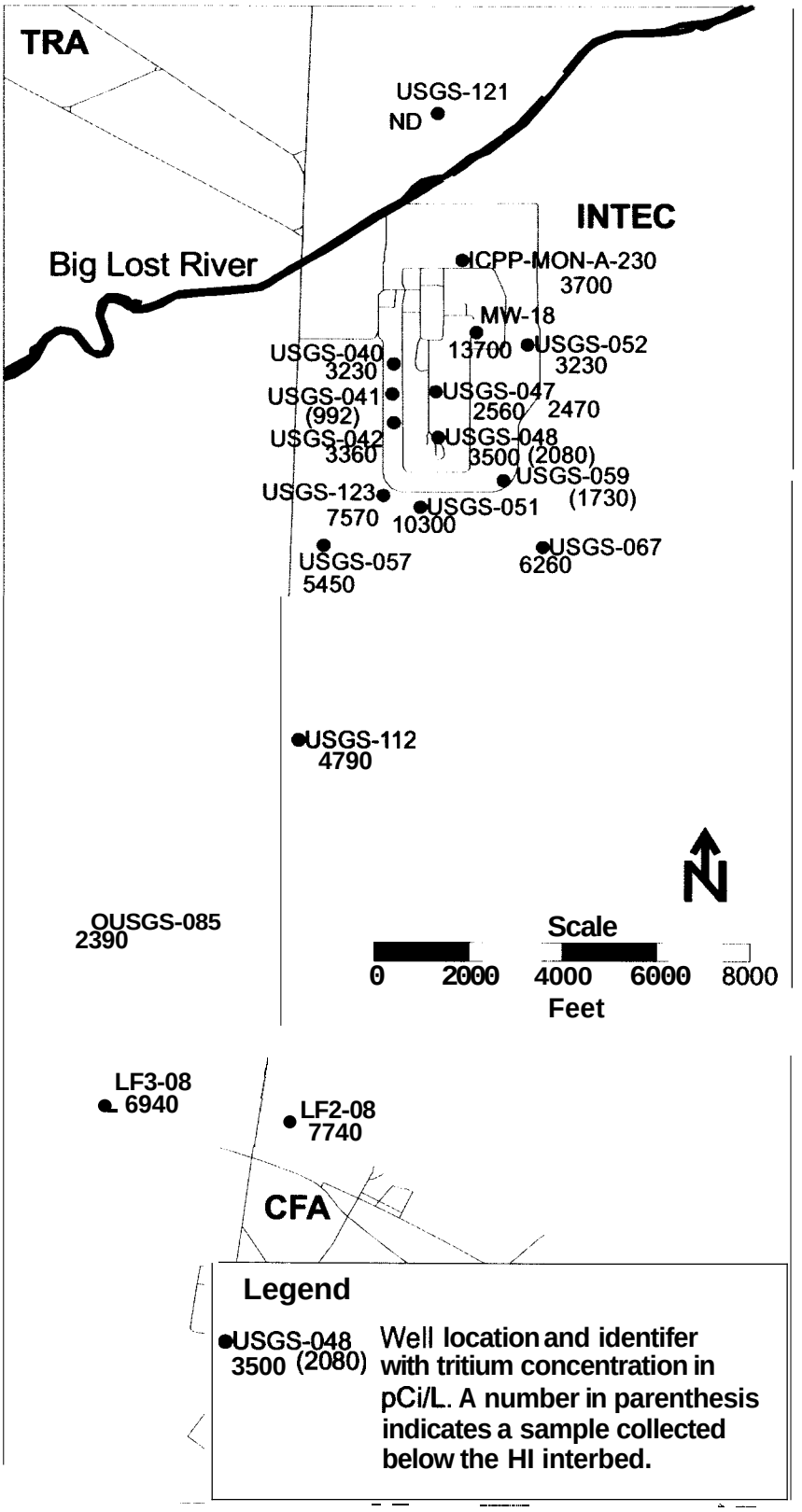

Figure A-4. Distribution of tritium (pCi/L) in the Snake River Plain Aquifer in **2003.**

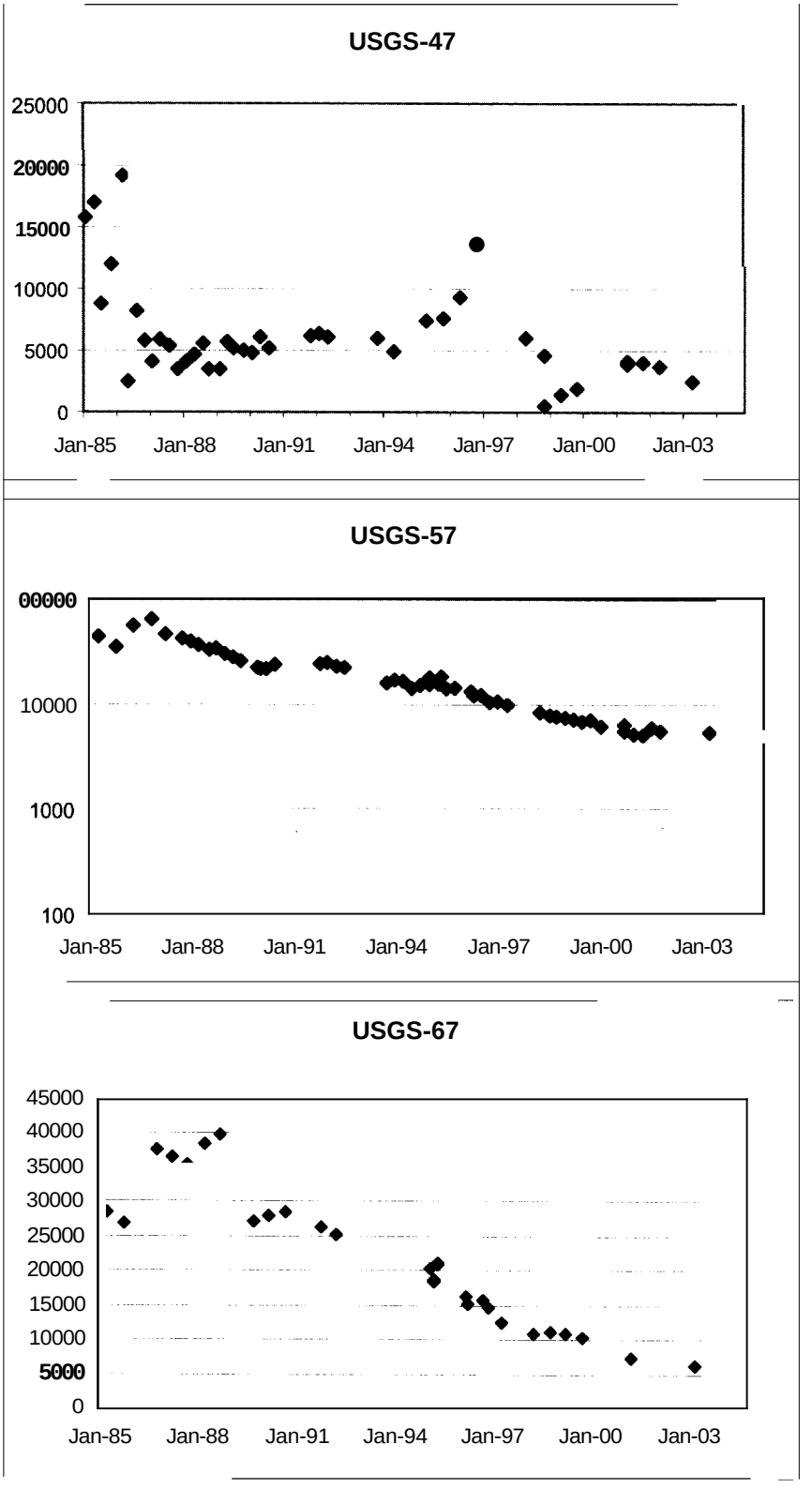

Figure **A-5.** Tritium concentration (pCi/L) trends for select wells near INTEC.

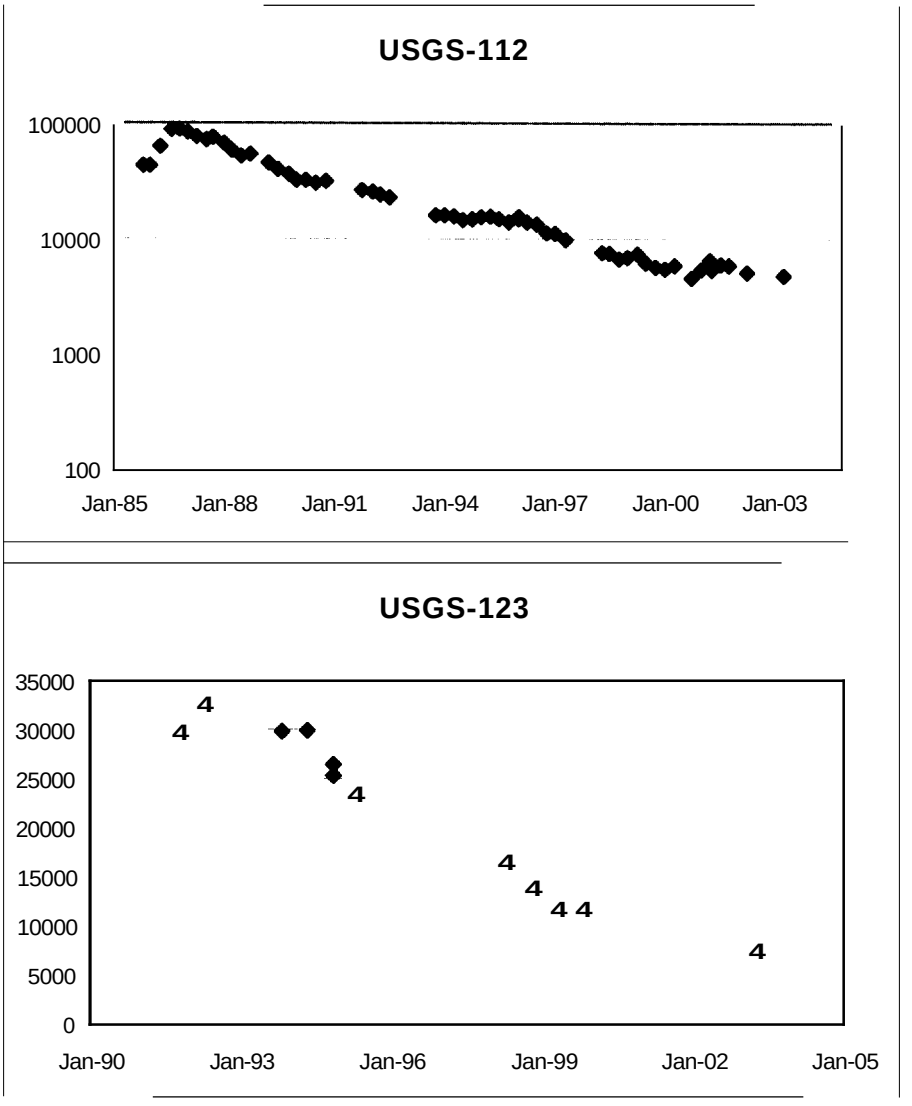

Figure **A-5.** (continued).

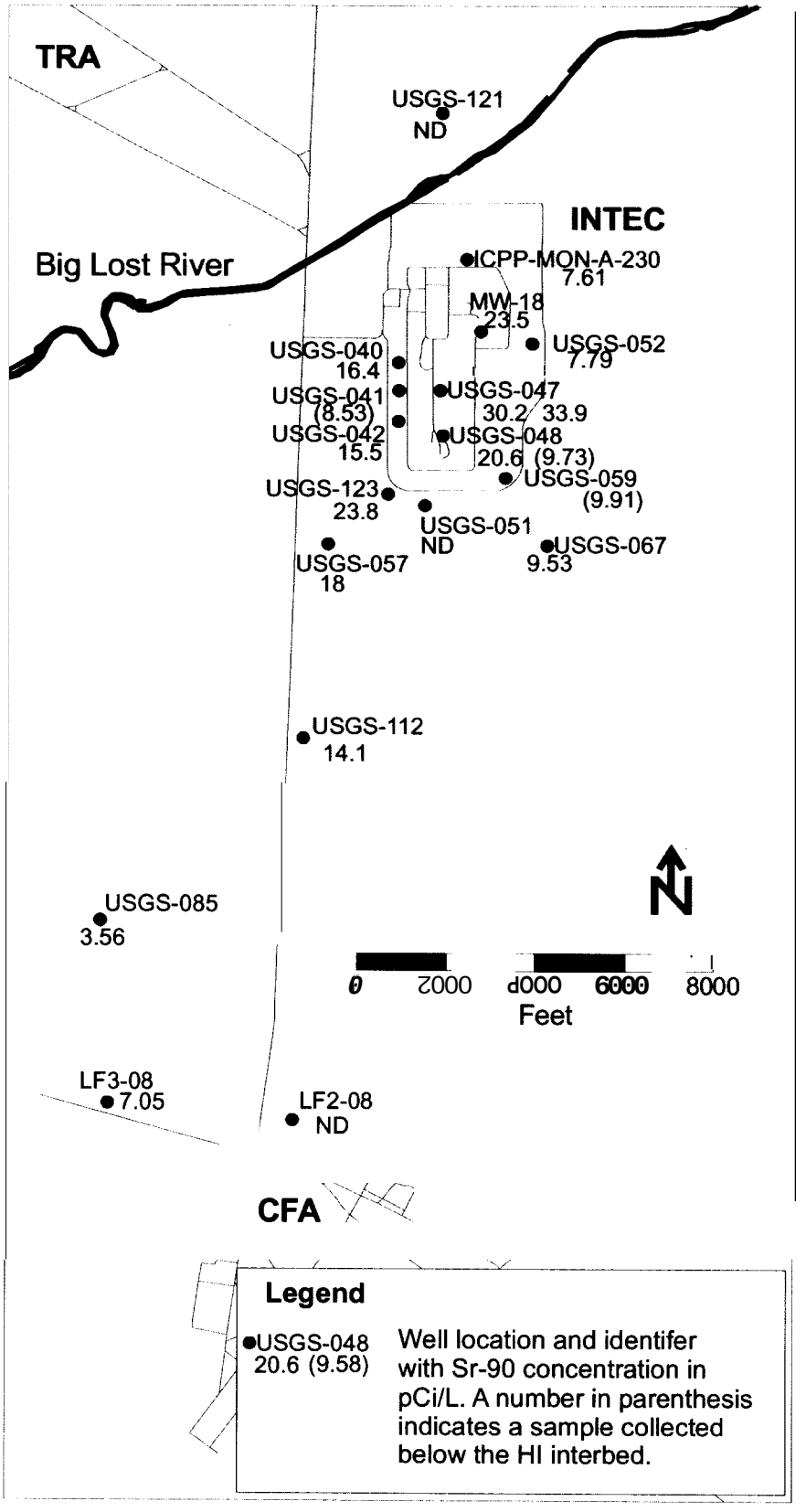

Figure A-6. Distribution of Sr-90 (pCi/L) in the Snake River Plain Aquifer in May 2003.

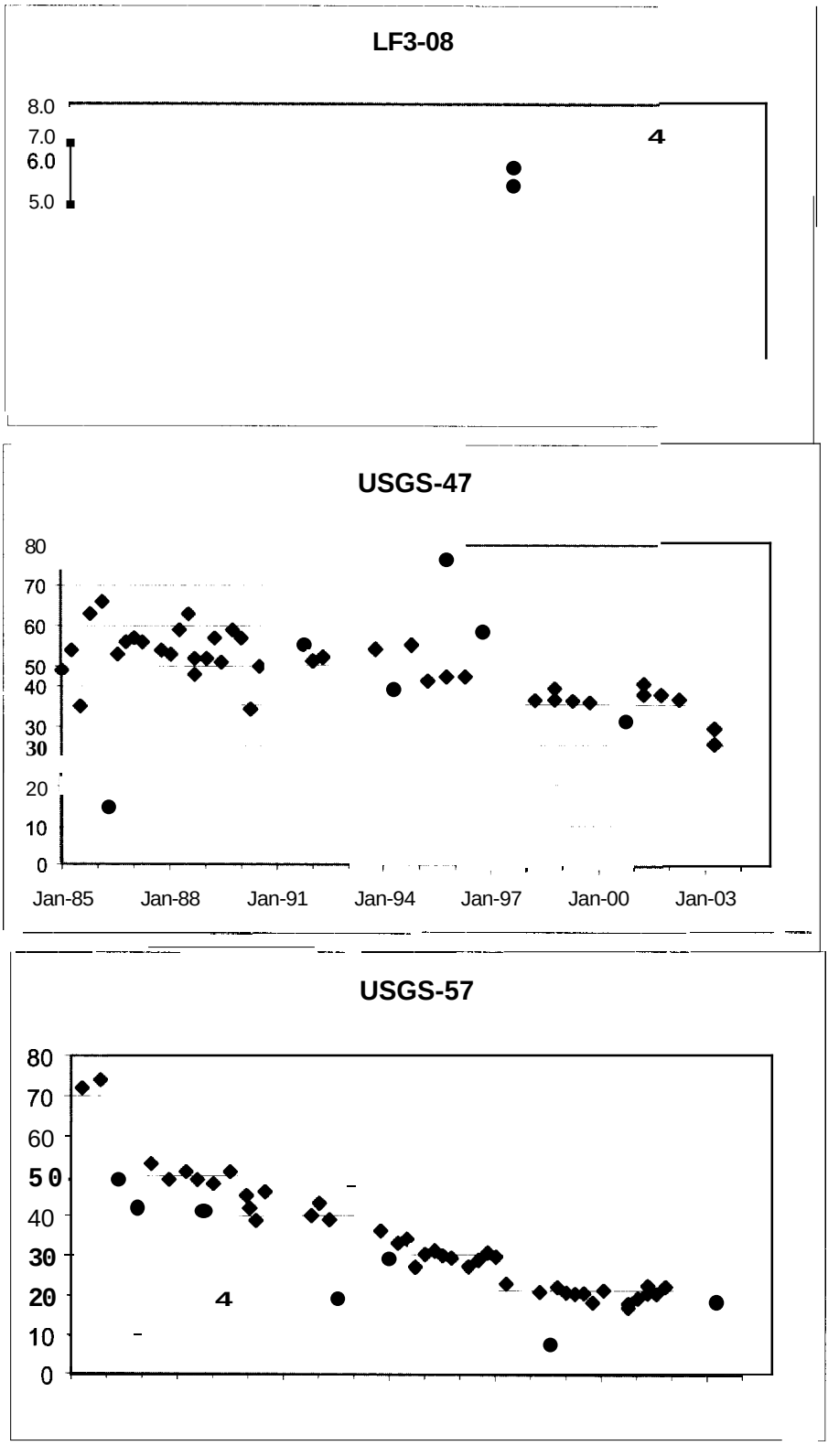

Figure **A-7.** Strontium-90 concentration (pCi/L) trends for select **wells** near INTEC.

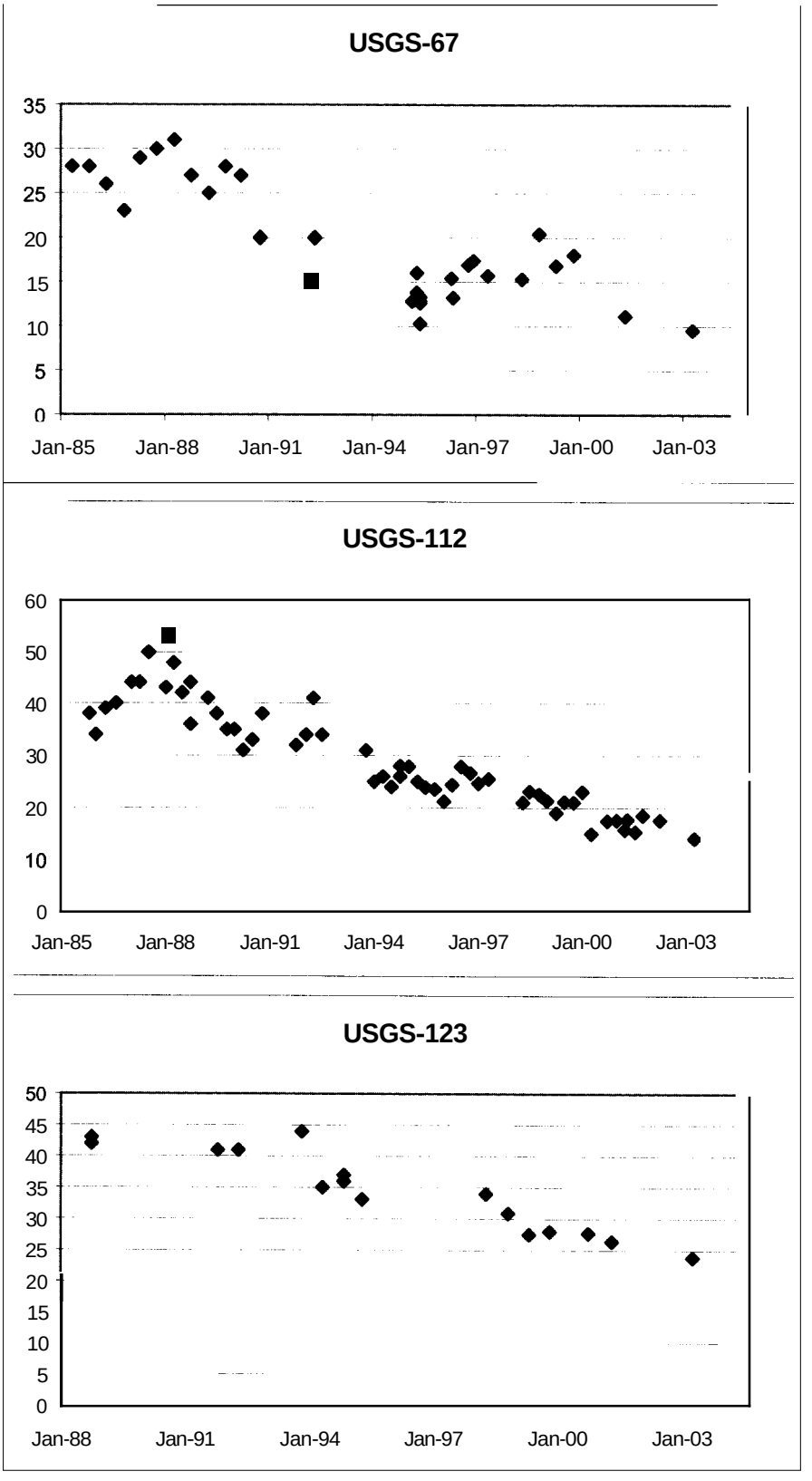

Figure A-7. (continued).

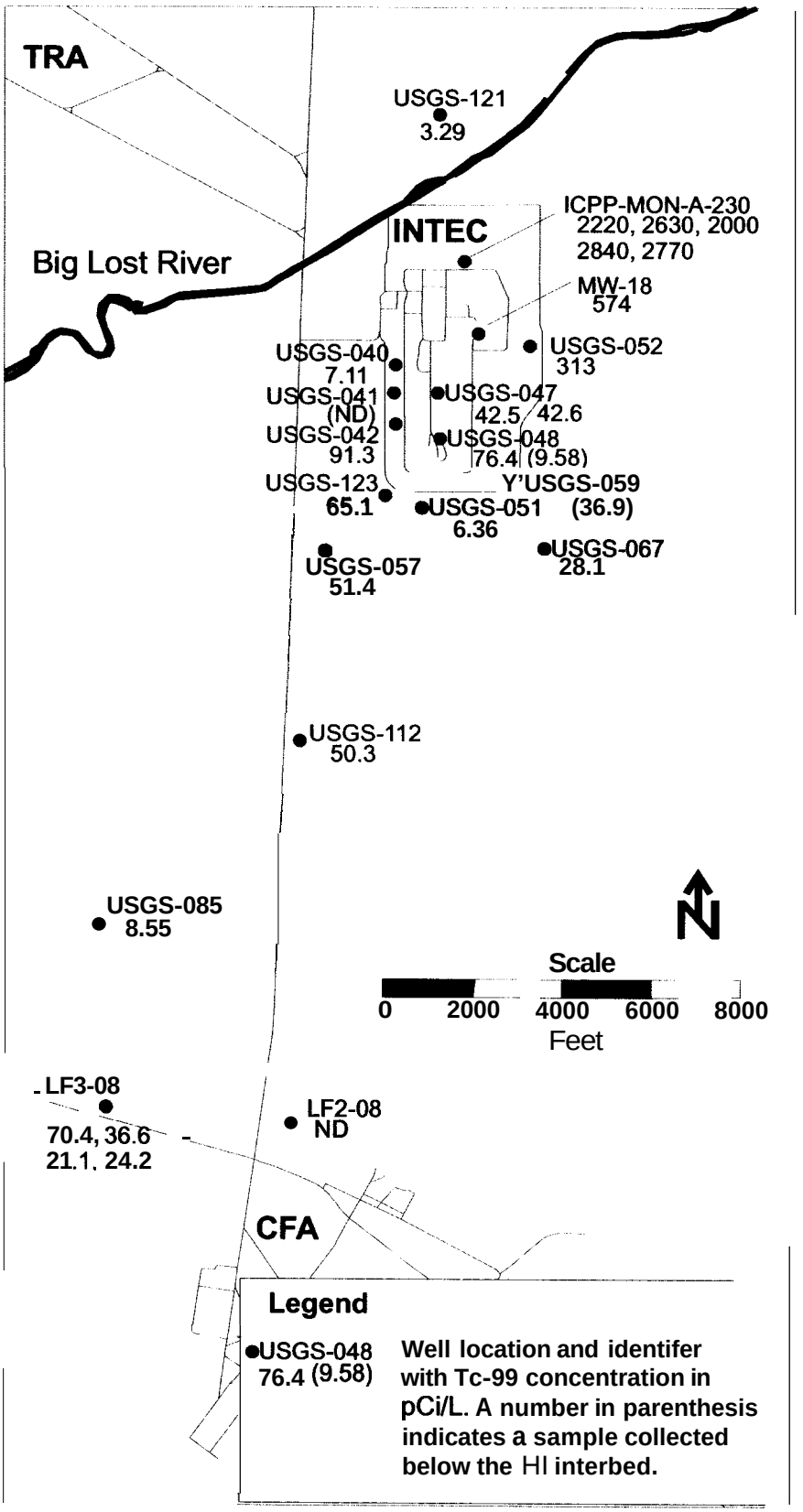

Figure **A-8. Distribution of** Tc-99 **(pCi/L) in the Snake River Plain Aquifer in May 2003.**

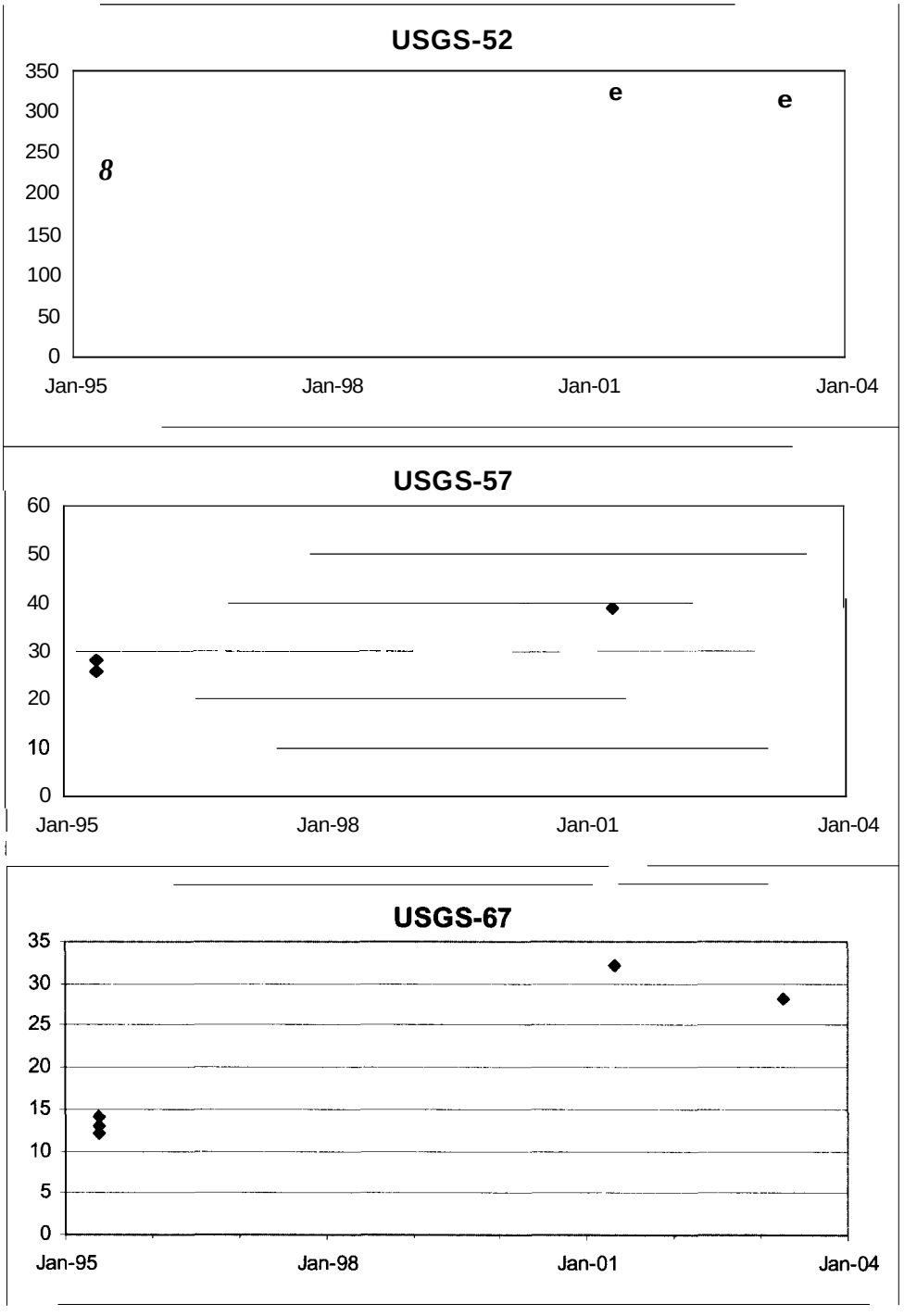

Figure A-9. Tc-99 concentration (pCi/L) trends for selected wells near INTEC.

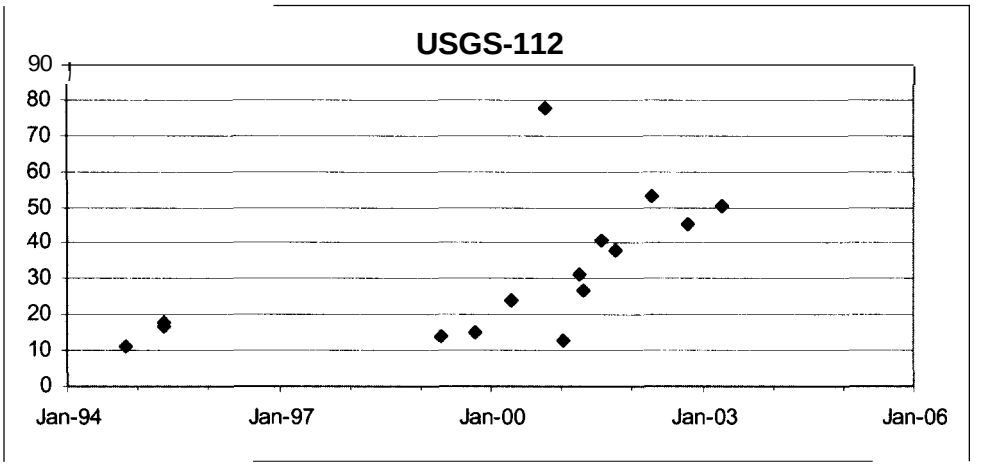

Figure **A-9.** (continued).

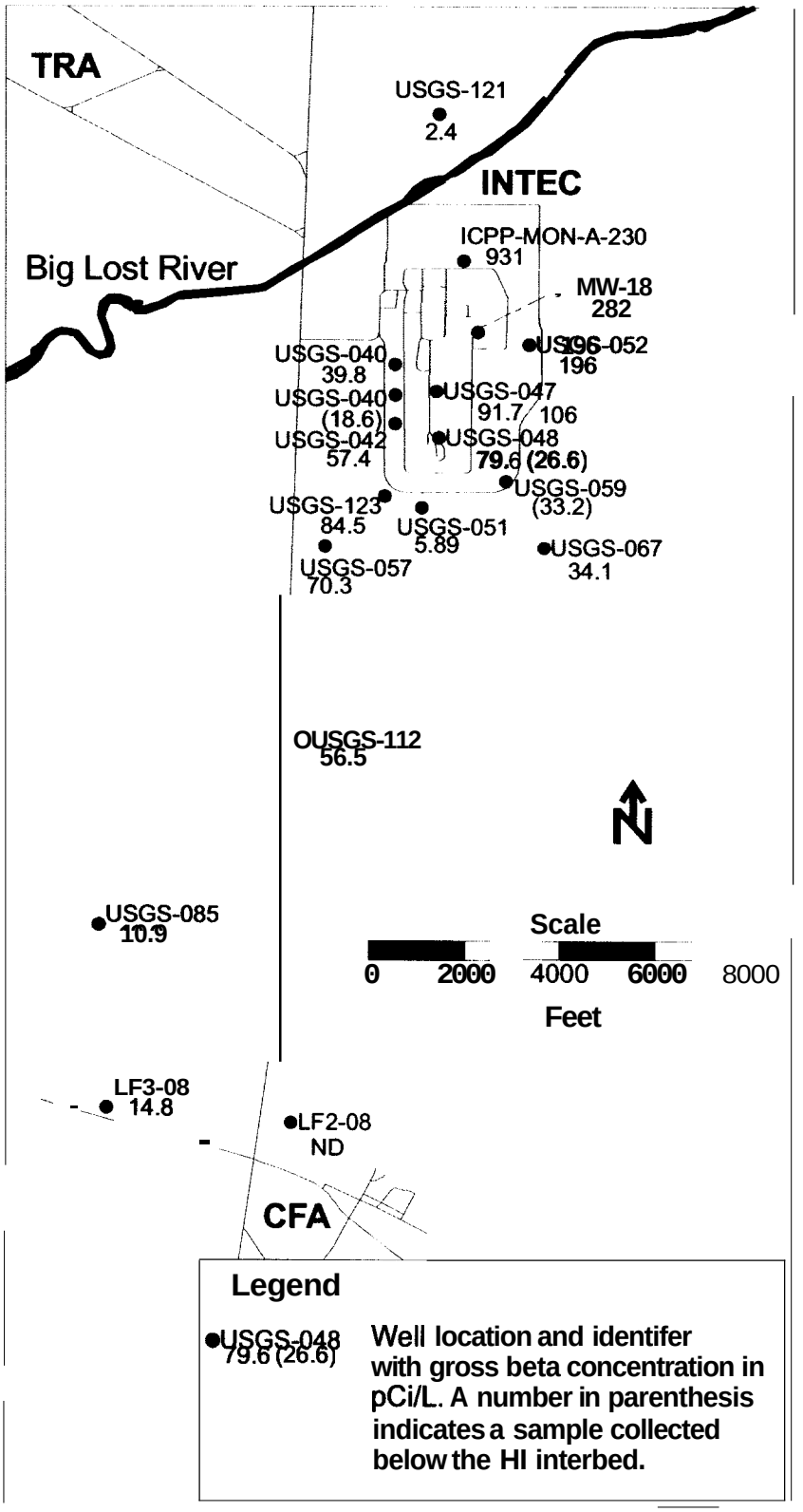

Figure **A-10.** Distribution of gross beta in pCi/L in the Snake River Plain Aquifer in May **2003.**

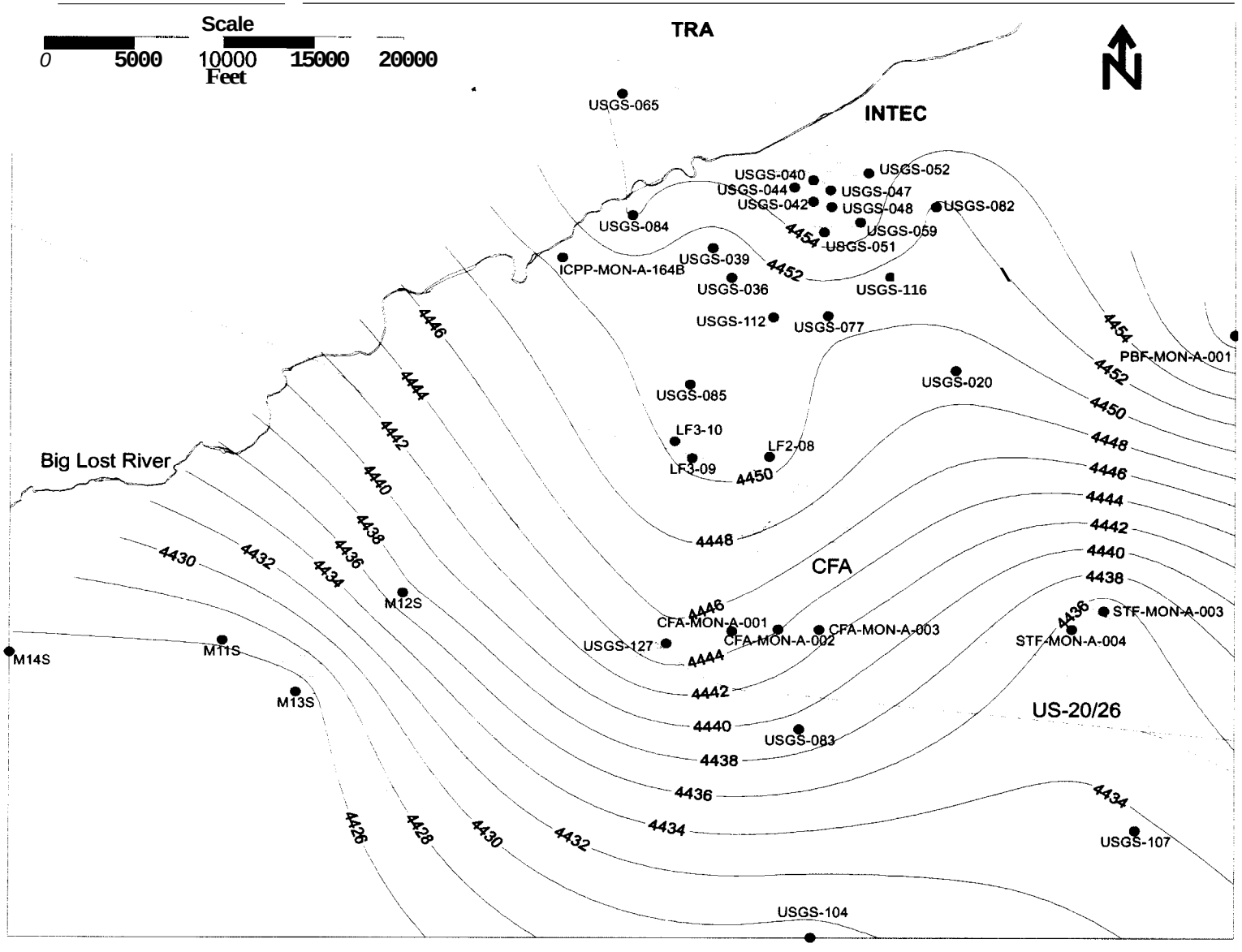

Figure **A-1** 1. Water-level contour plot for **May 2003** (ft above sea level).

Table A-1. Summary of gross beta, iodine-129, Tc-99, Sr-90, tritium, and gross alpha in the Snake River Plain Aquifer in 2003.[a,b]

Location	Sampling Date	Gross Beta (MCL= 4mrem/yr) pCi/L	+/-		Iodine-129 (MCL=1 pCi/L) pCi/L	+/-		Technetium-99 (MCL=900 pCi/L) pCi/L	+/-		Strontium-90 (MCL=8 pCi/L) pCi/L	+/-		Tritium (MCL=20,000 pCi/L) pCi/L	+/-		Gross Alpha (MCL=15 pCi/L) pCi/L	+/-	
ICPP-MON-A-230[c]	5/13/03	931	19.1	J	0.12	0.03		**2220**	37.7		7.61	1.05		3700	178		**32.7**	2.72	J
LF2-08	5/28/03	-0.19	0.63	UJ	0.59	0.05		-4.50	2.43	U	-0.13	0.11	u	7740	285		0.06	0.35	UJ
LF3-08[c]	5/27/03	14.8	1.26	J	0.77	0.08		1970	34.6	R	7.05	0.89		6940	273		4.27	1.01	J
MW-18	5/13/03	282	7.00	J	0.60	0.06		574	10.7		**23.5**	3.30		13700	324		**15.0**	1.84	J
USGS-040	4/14/03	39.8	1.57	J	0.24	0.07	J	7.11	1.96	UJ	**16.4**	2.19		3230	143		1.66	0.75	UJ
USGS-042	4/3/03	57.4	1.92	J	0.74	0.08	J	91.3	3.41		**15.5**	2.00		3360	148		1.85	0.90	UJ
USGS-047	4/10/03	91.7	2.31	J	0.46	0.05		42.5	2.52		**30.2**	3.84		2560	137		2.23	0.73	J
USGS-047 Dup	4/10/03	106	2.68	J	0.52	0.05		42.6	2.57		**33.9**	4.96		2470	133		4.81	1.59	J
USGS-048	4/10/03	79.6	2.19	J	0.31	0.05		76.4	3.21		**20.6**	2.96		3500	146		3.35	1.03	J
USGS-051	4/2/03	5.89	0.74	J	0.20	0.03		6.36	1.93	UJ	0.08	0.13	U	10300	222		0.35	0.97	UJ
USGS-052	4/14/03	196	3.46	J	0.14	0.03	J	313	6.77		7.79	1.18		3230	145		13.2	1.78	J
USGS-057	4/7/03	70.3	1.69	J	0.51	0.04		51.4	2.68		**18.0**	3.08		5450	172		0.59	0.77	UJ
USGS-067	4/7/03	34.1	1.48	J	0.31	0.05	J	28.1	2.32		**9.53**	1.57		6260	180		3.20	1.11	J
USGS-085	4/9/03	10.9	0.91	J	0.17	0.03		8.55	1.93	UJ	3.56	0.62		2390	129		1.76	0.80	UJ
USGS-112	4/9/03	56.5	1.90	J	-0.01	0.02	U	50.3	2.70		**14.1**	1.85		4790	156		5.26	1.42	J
USGS-121	4/15/03	2.4	0.59	J	-0.01	0.02	U	3.29	1.82	U	-0.14	0.13	U	171	99.2	U	3.36	0.94	J
USGS-123	4/7/03	84.5	2.28	J	0.36	0.06		65.1	2.93		**23.8**	3.12		7570	191		10.4	1.95	J
USGS-041 below HI	7/31/03	18.6	0.79	J	.06	.03	U	1.76	2.21	U	**8.53**	1.38		992	110		2.06	0.33	J
USGS-048 below HI	8/6/03	26.6	1.63	J	.25	.05		9.58	2.81		**9.73**	1.22		2080	141		2.65	0.93	UJ
USGS-059 below HI	7/29/03	33.2	1.71	J	.14	.04		36.9	3.23		**9.91**	1.49		1730	127		3.06	0.73	J

a. Bold indicates a value equal or greater than the MCL.
b. "U" indicates that an analyte was not detected. "J" indicates an estimated value. "UJ" indicates that the radionuclide may or may not be present, and the result is considered highly questionable. The associated value is an estimate and may be inaccurate or imprecise. The result is considered a nondetect for project data interpretation purposes.
c. Resampled on August 11,2003. Results are in Table A-3.

Table A-2. Summary of other analytes detected in the Snake River Plain Aquifer in 2003.[a,b]

Location	Sampling Date	Uranium-233/234[c] pCi/L	+/-		Uranium-235[c] pCi/L	+/-		Uranium 238[c] pCi/L	+/-		Cesium-137 (MCL=200 pCi/L) pCi/L	+/-		Mercury (MCL=2 µg/L) µg/L	
ICPP-MON-A-230	5/13/03	1.910	0.218		0.189	0.051		1.000	0.138		0.531	0.955	U	0.095	U
LF2-08	5/28/03	-0.001	0.043	U	0.0055	0.0543	U	-0.036	0.030	U	-0.765	0.879	U	0.095	U
LF3-08	5/27/03	1.690	0.233		0.103	0.0517	U	0.789	0.143		0.983	0.966	U	0.095	U
MW-18	5/13/03	1.930	0.221		0.115	0.0445	UJ	0.924	0.130		1.49	1.00	U	0.095	U
USGS-040	4/14/03	1.480	0.132		0.107	0.028		0.673	0.071		9.73	2.14		0.052	U
USGS-042	4/3/03	1.560	0.124		0.141	0.0246		0.786	0.073		18.4	2.51		0.052	U
USGS-047	4/10/03	1.570	0.118		0.058	0.0139		0.688	0.061		5.15	1.58		0.148	B
USGS-047	4/10/03	1.530	0.122		0.0624	0.0156		0.691	0.066		6.97	2.08		0.185	B
USGS-048	4/10/03	1.790	0.144		0.0874	0.0219		0.856	0.081		0.089	1.45	U	0.112	B
USGS-051	4/2/03	0.744	0.082		0.0904	0.0288		0.489	0.060		-0.018	0.977	U	0.052	U
USGS-052	4/14/03	1.550	0.142		0.134	0.0277		0.816	0.086		-0.620	0.858	U	0.052	U
USGS-057	4/7/03	1.640	0.189		0.0651	0.0296	UJ	0.750	0.111		0.82	1.14	U	0.052	U
USGS-067	4/7/03	0.923	0.096		0.0568	0.0198	J	0.497	0.062		-1.03	1.05	U	0.052	U
USGS-085	4/9/03	1.490	0.134		0.147	0.0288		0.649	0.072		0.401	0.888	U	0.052	U
USGS-112	4/9/03	1.450	0.136		0.110	0.0255		0.767	0.083		0.704	1.77	U	0.052	U
USGS-121	4/15/03	1.540	0.142		0.101	0.0246		0.788	0.084		0.043	1.02	U	0.052	U
USGS-123	4/7/03	1.440	0.131		0.0416	0.0158	J	0.739	0.078		1.16	1.85	U	0.104	B
USGS-041 below HI	7/31/03	1.27	0.15		0.08	0.03	UJ	0.68	0.09		6.17	2.66	UJ	0.03	UJ
USGS-048 below HI	8/6/03	1.48	0.19		0.22	0.07		0.52	0.10		6.08	2.82	UJ	0.03	U
USGS-059 below HI	7/29/03	1.47	0.23		0.01	0.03	U	0.64	0.14		-1.42	0.89	U	0.03	UJ

Table **A-2.** (continued).

Location	Sampling Date	Americium-241[d] pCi/L	+/-		Neptunium-237[d] pCi/L	+/-		Plutonium-238[d] pCi/L	+/-		Plutonium-239/240[d] pCi/L	+/-		Plutonium-241 (MCL=300 pCi/L) pCi/L	+/-	
	5/13/03	-0.0056	0.0040	U	0.0154	0.0378	U	-0.0090	0.0045	U	0.0004	0.0104	U	-0.279	1.68	U
LF2-08	5/28/03	0.0469	0.0333	U	-0.0071	0.0236	U	0.0663	0.0300	UJ	0.0373	0.0138	UJ	1.95	2.03	U
LF3-08	5/27/03	0.0120	0.0162	U	0.0080	0.0289	U	0.0251	0.0340	U	0.0209	0.0139	U	-2.92	2.99	U
MW-18	5/13/03	0.0000	1.0000	U	0.0626	0.0496	U	0.0000	1.0000	U	0.0142	0.0205	U	-3.01	2.42	U
USGS-040	4/14/03	0.0026	0.0059	U	0.0033	0.0194	U	0.0210	0.0108	U	0.0038	0.0038	U	0.699	2.54	U
USGS-042	4/3/03	0.0028	0.0049	U	-0.0039	0.0039	U	0.0086	0.0061	U	-0.0193	0.0112	u	7.93	2.69	UJ
USGS-047	4/10/03	0.0000	0.0046	U	-0.0324	0.0123	U	-0.0175	0.0107	U	0.0112	0.0140	U	8.89	2.96	UJ
USGS-047	4/10/03	-0.0059	0.0072	U	0.0045	0.0155	U	0.0116	0.0075	U	-0.0078	0.0113	U	10.60	3.15	UJ
USGS-048	4/10/03	0.0122	0.0061	U	-0.0066	0.0215	U	-0.0145	0.0059	U	-0.0092	0.0090	U	-2.67	4.65	U
USGS-051	4/2/03	0.0094	0.0058	U	-0.0183	0.0232	U	-0.0126	0.0169	U	-0.0217	0.0210	U	4.08	2.68	U
USGS-052	4/14/03	0.0097	0.0049	U	-0.0157	0.0155	U	0.0059	0.0059	U	-0.0052	0.0120	U	3.25	2.69	U
USGS-057	4/7/03	0.0095	0.0083	U	-0.0163	0.0210	U	0.0000	1.0000	U	0.0000	1.0000	U	2.42	2.79	U
USGS-067	4/7/03	0.0210	0.0112	U	-0.0495	0.0299	U	0.0000	1.0000	U	0.0094	0.0122	U	7.71	3.22	UJ
USGS-085	4/9/03	0.0124	0.0066	U	-0.0151	0.0149	U	-0.0040	0.0106	U	0.0048	0.0128	U	2.98	2.55	U
USGS-112	4/9/03	-0.0079	0.0080	U	-0.0129	0.0217	U	-0.0016	0.0052	U	-0.0032	0.0074	U	0.672	2.87	U
USGS-121	4/15/03	0.0178	0.0077	UJ	0.0493	0.0280	U	0.0013	0.0059	U	-0.0340	0.0154	U	0.691	2.51	U
USGS-123	4/7/03	0.0136	0.0061	J	-0.0140	0.0081	U	0.0000	1.0000	U	0.0043	0.0043	U	-2.41	2.68	U
USGS-041 below HI	7/31/03	0.0131	0.0178	U	0.0232	.02333	U	0.0125	0.0169	U	-0.00788	0.00559	U	-1.64	2.78	U
USGS-048 below HI	8/6/03	0.0096	0.0195	U	-0.0165	0.0209	U	-0.0111	0.0193	U	-0.0273	0.0104	U	8.99	2.54	
USGS-059 below HI	7/29/03	0.00937	0.0190	U	0.00162	0.0318	U	-0.0148	0.00743	U	0.00924	0.0291	U	1.02	2.67	U

a. Gamma spectrometry analysis includes antimony-125; cerium-144; Cs-134 and -137; cobalt-58 and -60; europium-152, -154, and -155; manganese-54; niobium-95; ruthenium-103 and -106; silver-IO8 and -110; zinc-65; zirconium-95; and results greater than 2σ and greater than the minimal detectable activity.

b. "U" indicates that an analyte was not detected. "J" indicates an estimated value. "UJ" indicates that analyte may or may not be present, the result is considered highly questionable, and the reported value is only an estimate. The result is considered a nondetect for project data interpretation purposes.

c. MCL is set for total uranium at 30 μg/L.

d. The MCL for gross alpha activity (15 pCi/L) applies to Am-241, Np-237, Pu-238, and Pu-239/240.

Table A-3. Summary of Tc-99 resampling results (August 11,2003).

Well	Laboratory	Tc-99 pCi/L	+/-	
LF3-08	Sevem Trent	70.4	8	J[a]
	Severn Trent	36.6	4.6	J
	GEL	21.1	2.61	
	GEL	24.2	2.61	
ICPP-MON-A-230	Severn Trent	2630	260	
	Sevem Trent	2000	200	
	GEL	2840	43.4	
	GEL	2770	42.2	

a. "J" indicates **an estimated value.**

Table A-4. Water-level measurements for May 2003.

Well Name	Date	Time	Stickup (ft)	Brass Cap Elevation (ft)	Water-level (ft-bmp)	Deviation Correction (ft)[a]	Water-level Elevation (ft)
CFA-MON-A-001	5/13/03	1330	2.07	4936.44	493.72		4444.79
CFA-MON-A-002	5/13/03	1345	1.94	4932.24	490.06		4444.12
CFA-MON-A-003	5/13/03	1355	1.61	4930.31	489.42		4442.50
ICPP-MON-A-164B	5/14/03	1220	2.75	4948.66	501.01		4450.40
ICPP-MON-A-230	5/13/03	1445	2.35	4912.41	463.2		4451.56[b]
LF2-08	5/14/03	1015	1.64	4931.72	485.62	2.95	4450.69
LF3-09	5/14/03	1030	2.40	4941.08	493.15	0.12	4450.45
LF3-10	5/14/03	1040	2.12	4942.62	494.47		4450.27
MW-18	5/13/03		2.71	4913.74	465.55		4450.90
USGS-020	5/13/03	1120	0.77	4916.36	468.37		4448.76
USGS-034	5/13/03	1343	1.07	4929.19	475.04		4455.22
USGS-035	5/13/03	1354	1.55	4929.64	476.12	0.28	4455.35
USGS-036	5/13/03	1500	1.18	4929.20	479.45		4450.93
USGS-039	5/13/03	1405	1.23	4930.95	481.64		4450.54
USGS-040	5/13/03	750	1.12	4919.68	466.06		4454.74
USGS-042	5/13/03	805	0.83	4921.35	467.35		4454.83
USGS-044	5/13/03	1342	1.45	4921.42	467.54		4455.33

Table A-4. (continued).

Well Name	Date	Time	Stickup (ft)	Brass Cap Elevation (ft)	Water-level (ft-bmp)	Deviation Correction (ft)[a]	Water-level Elevation (ft)
USGS-045	5/13/03	1327	1.21	4921.79	469.27		4453.73
USGS-047	5/13/03	900	-1.13	4919.91	463.86		4454.92
USGS-048	5/13/03	820	1.31	4920.48	466.67		4455.12
USGS-051	5/12/03		1.98	4922.24	469.25		4454.97
USGS-052	5/13/03	930	1.86	4912.96	460.25	0.17	4454.74
USGS-059	5/14/03	1305	1.47	4,916.92	463.58	0.16	4454.97
USGS-065	5/13/03	1420	0.58	4925.01	471.3		4454.29
USGS-077	5/13/03	1000	2.18	4921.79	473.61		4450.36
USGS-082	5/13/03	1145	1.57	4906.99	456.9		4451.66
USGS-083	5/13/03	1430	2.15	4941.59	504.45		4439.29
USGS-084	5/14/03	1230	1.70	4,941.40	488.93		4454.17
USGS-085	5/13/03	1510	2.27	4939.26	490.8	0.13	4450.86
USGS-104	5/13/03	1413	2.98	4988.65	562.53	0.13	4429.23
USGS-107	5/13/03	1348	1.97	4917.50	485.7		4433.77
USGS-112	5/13/03	1100	2.23	4927.84	482.16	2.73	4450.64
USGS-116	5/13/03	1110	2.53	4916.03	467.54	0.18	4451.20
USGS-121	5/13/03	1040	1.90	4909.65	461.52	1.5	4451.53
USGS-127	5/13/03	1630	1.85	4956.44	512.85	0.1	4445.54
PBF-MON-A-001	5/14/03	845	1.92	4906.15	449.09		4458.98
M11S	5/13/03	1035	1.48	4994.19	569.4		4426.27
M12S	5/13/03	1050	1.74	4975.28	539.65		4437.37
M13S	5/13/03	1105	1.75	5026.85	604.38	0.49	4424.71
M14S	5/13/03	835	2.78	5032.46	609.8		4425.44
STF-MON-A-003	5/14/03	929	2.05	4937.01	504.4	0.14	4434.80
STF-MON-A-004	5/14/03	941	2.16	4945.37	512.11	0.1	4435.52

a. Wells with deviation corrections less than 0.1 ft were not adjusted.
b. Measurement taken by sampling crew with different water-level indicator.

Appendix B

Analytical Results

Appendix B

Analytical Results This appendix presents the groundwater analytical results. Sampling and analysis of groundwater was conducted during April and May 2003. The complete data set for perched groundwater and quality assurance data is provided as supplemental information on CD but is not part of this controlled document. The quality control samples are designated in the location field as either field blank or equipment rinsate. The data are sorted by constituent in one table and by location in another table. The data qualifier flags used in this appendix are defined as follows:

Inorganic Oualifier Data Flags

B—The result is less than the reporting limit required by the contract but is greater than or equal to the instrument detection limit.

J—The associated value is estimated.

E—The post digestion spike was outside control limits.

N—Matrix spike recovery was outside control limits.

U—The analyte was not detected.

UJ—The analyte may or may not be present, and the result is considered highly questionable. The associated value is an estimate and may be inaccurate or imprecise. The result is considered a nondetect for project data interpretation purposes.

Radiological Qualifier Data Flags

J—The associated value is estimated. The result may not be an accurate representation of the amount of activity actually present in the sample.

R—The accuracy of the data is so questionable that it is recommended that the data not be used. The "R" flag indicates the data have been rejected, and overrides all other applicable flags.

U—The radionuclide is not considered present in the sample (i.e., nondetect).

UJ—The radionuclide may or may not be present, and the result is considered highly questionable. The associated value is an estimate and may be inaccurate or imprecise. The result is considered a nondetect for project data interpretation purposes.